LIVE 2012

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LIVE 2012 Symposium will be submitted to be approved with CME credits by the EACCME of the UEMS

Development of a Prognostic Model for Fistula Maturation in Patients with Advanced Renal Failure

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NHS Lothian

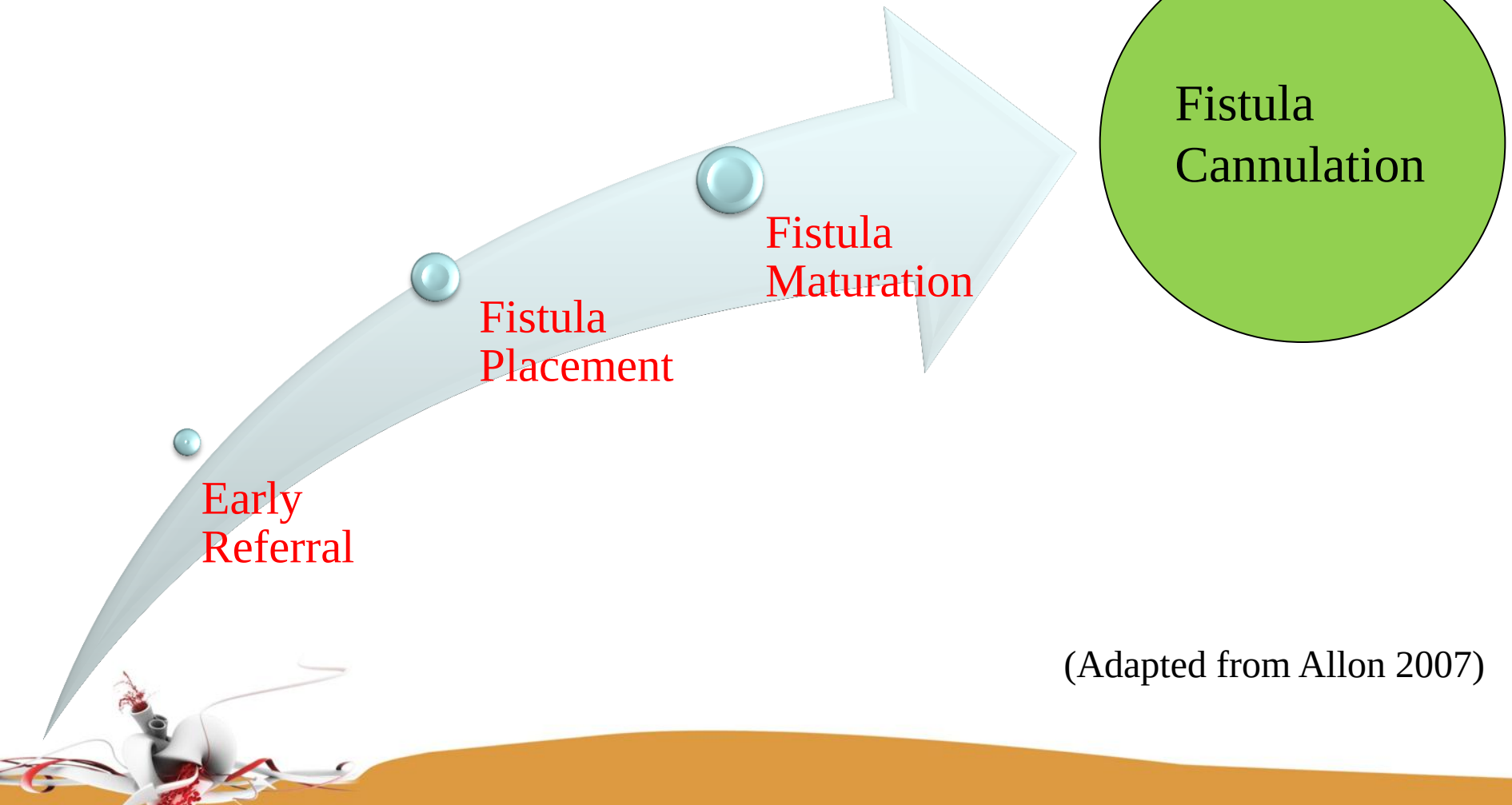
Queen Margaret University EDINBURGH

Background

- The worldwide growth of patients with end-stage kidney disease requiring renal replacement therapy (RRT) in the form of dialysis or transplantation is over 6% per annum (Grassmann et al. 2006).

- The arteriovenous fistula is the ideal vascular access. A significant number of arteriovenous fistula (28 to 53%) fail to mature to support dialysis (Asif et al. 2005).

"Fistula Hurdles"



(Adapted from Allon 2007)

Study Aim

To explore the role of blood markers and patient factors in the predication of maturation of arteriovenous fistula in patients who have undergone vascular access surgery at the Royal Infirmary of Edinburgh.

Methodology

Research Design

Retrospective Study

Setting/Location of study

Royal Infirmary of Edinburgh

Intervention

Creation of Autologous Arteriovenous Fistulae

Sample Size

300 patients undergoing fistula creation between 2006 and 2009

Ethical Approval

Lothian Research Ethics Committee
Queen Margaret University Ethics Committee

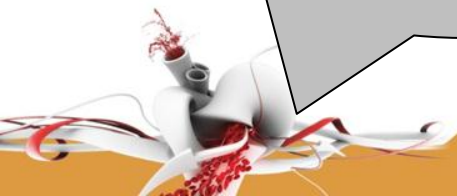
Predictive Variables

Coagulation Profile
- Prothrombin Time (PT)
- International Normalisation Ratio (INR)

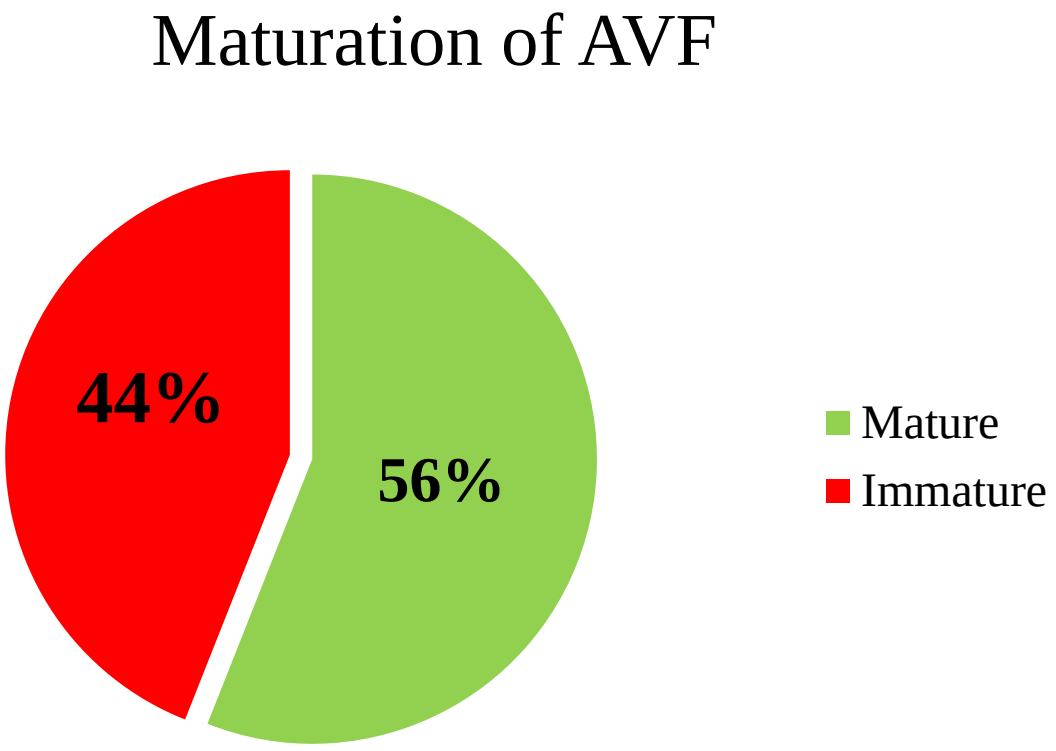
Kidney Function
- Glomerular Filtration Rate (GFR)
- Serum Potassium (K^+)
- Serum Sodium (Na)
- Serum Calcium (Ca)
- Bicarbonates (HCO_3)
- Blood Urea
- Creatinine

Risk Factors
- Gender
- Age
- Peripheral Vascular Diseases (PVD)
- Diabetes Mellitus (DM)
- Hypertension (HTN)
- Basal Metabolic Index (BMI)
- Dialysis
- Smoking
- Vein Size
- Type of Arteriovenous Fistulae
- Side of Arm

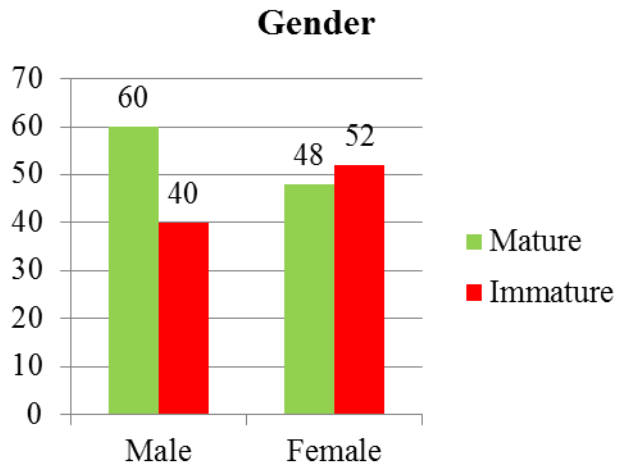
Lipid Profile
- High Density Lipoprotein (HDL)
- Triglyceride (TG)
- Total Cholesterol (TC)

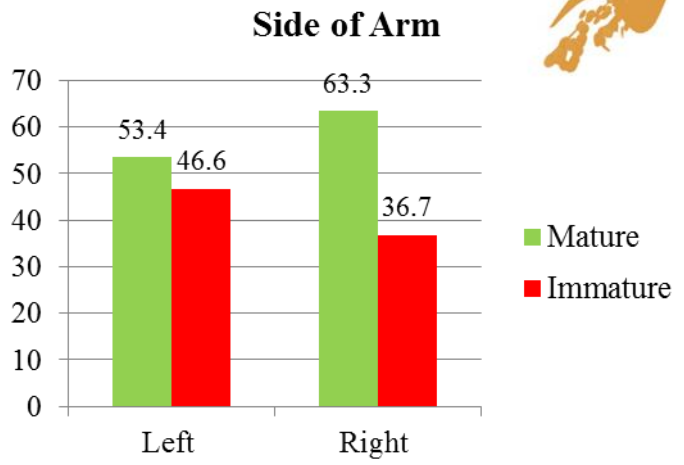


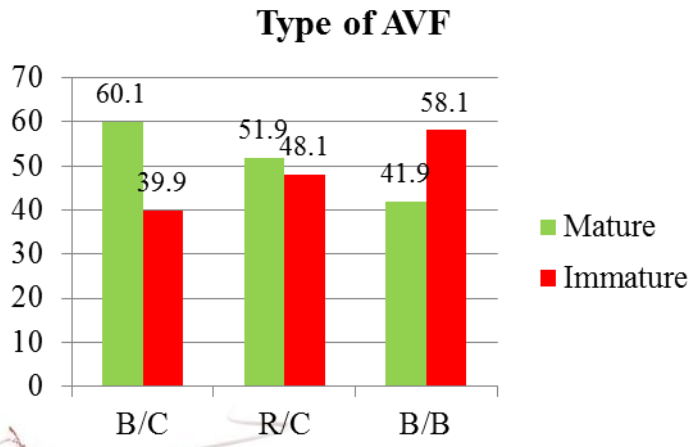
Results

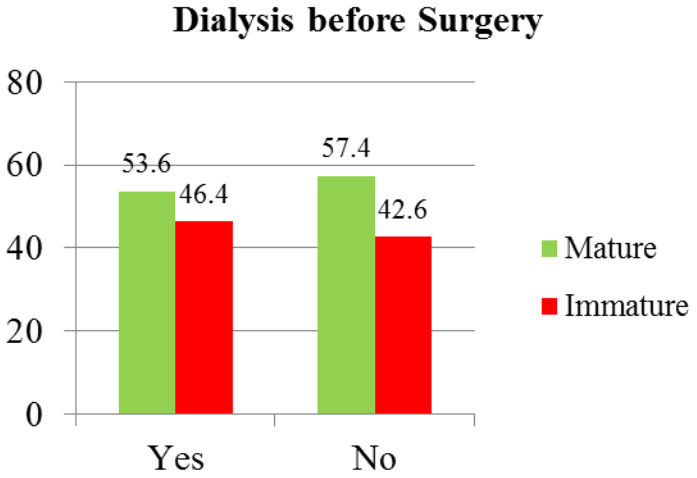


Results

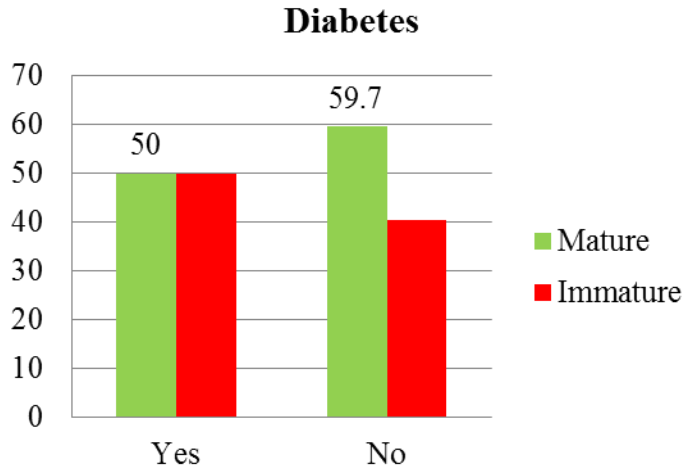

Gender
70
60
50
40
30
20
10
0
60
40
48
52
Male
Female
Mature
Immature

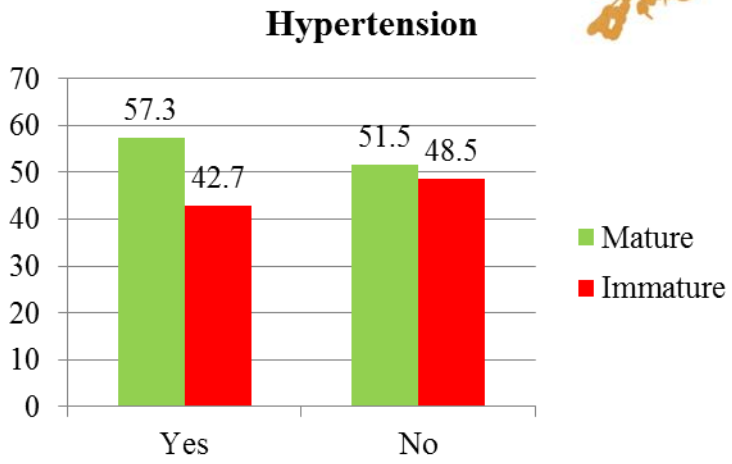

Side of Arm
70
60
50
40
30
20
10
0
53.4
46.6
63.3
36.7
Left
Right
Mature
Immature

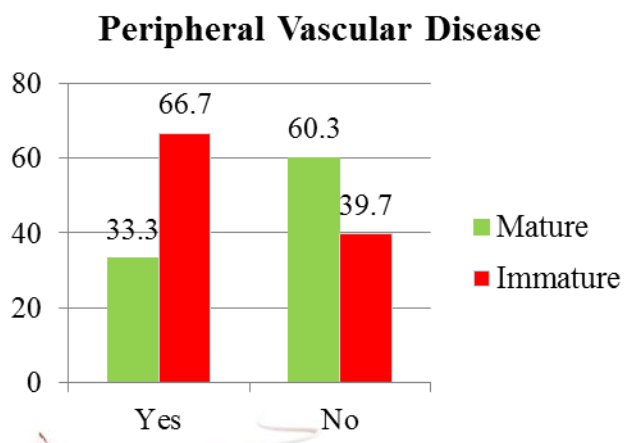

Type of AVF
70
60
50
40
30
20
10
0
60.1
39.9
51.9
48.1
41.9
58.1
B/C
R/C
B/B
Mature
Immature

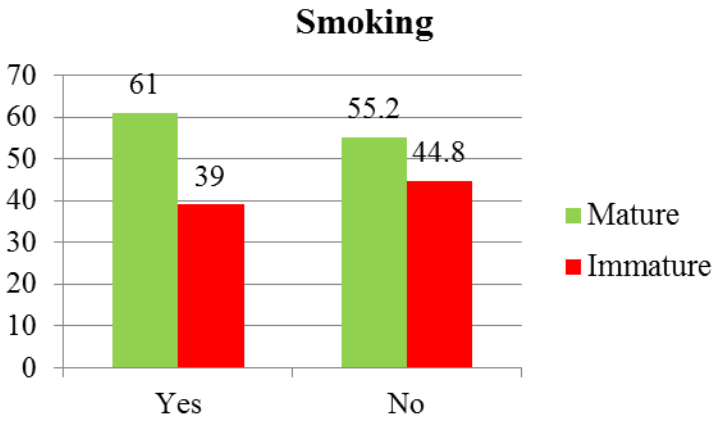

Dialysis before Surgery
80
60
40
20
0
53.6
46.4
57.4
42.6
Yes
No
Mature
Immature

Results


Diabetes
70
60
50
40
30
20
10
0
50
59.7
Yes
No
Mature
Immature


Hypertension
70
60
50
40
30
20
10
0
57.3
42.7
51.5
48.5
Yes
No
Mature
Immature


Peripheral Vascular Disease
80
60
40
20
0
33.3
66.7
60.3
39.7
Yes
No
Mature
Immature


Smoking
70
60
50
40
30
20
10
0
61
39
55.2
44.8
Yes
No
Mature
Immature

Univariate Analysis of Independent Variables

Clinical Characteristics	*Total %*	*% Mature AVF*	*Crude OR (95% CI)*	*P Value*
Age				0.45
> 50 yrs.	76.3	57.2		
≤ 50 yrs.	23.7	52.1	0.814(0.477-1.389)	
Gender				0.049*
Male	66.7	60		
Female	33.3	48	0.615 (0.379-0.998)	
Arm				0.129*
Left	73.7	53.4		
Right	26.3	63.3	1.505(0.887-2.553)	
Fistula				0.115*
B/C	62.7	60.1		
R/C	27	51.9	0.715 (0.423-1.208)	
BB	10.3	41.9	0.479 (0.222-1.036)	
PVD				0.001*
Yes	16	33.3		
No	84	60.3	3.04 (1.585-5.829)	
DM				0.102*
Yes	38	50		
No	62	59.7	1.48 (0.925-2.367)	

Univariate Analysis of Independent Variables

Clinical Characteristics	*Total %*	*% Mature AVF*	*Crude OR (95% CI)*	*P Value*
Smoker				0.49
No;	86.3	55.2	0.789 (0.402-1.547)	
Yes	13.7	61		
HTN				0.406
No	22	51.5	0.793 (0.458-1.371)	
Yes	78	57.3		
Dialysis				0.513
No	62.7	57.4	1.17 (0.731-1.873)	
Yes	37.3	53.6		
K				0.948
Abnormal	45.7	55.8	1.015 (0.642-1.605)	
Normal	54.3	56.2		
Na				0.439
Abnormal	14.7	61.4	1.295 (0.673-2.494)	
Normal	85.3	55.1		
Ca				0.525
> 2.5	13	51.3	0.804(0.41-1.577)	
≤ 2.5	87	56.7		

Univariate Analysis of Independent Variables

Clinical Characteristics	*Total %*	*% Mature AVF*	*Crude OR (95% CI)*	*P Value*
HCO3				0.743
>23	55	55.2	0.926 (0.586-1.465)	
≤ 23	45	57		
Creatinine				0.676
≤ 120	1	33.3	0.37 (0.033-4.182)	
>120 ≤400	54.3	55.2	0.913(0.576-1.447)	
>400	44.7	57.5		
Urea				0.949
≤ 6.6	15.7	57.4	1.09 (0.73-2.073)	
>6.6-≤15	18.7	57.1	1.076 (0.591-1.960)	
>15	65.7	55.3		
eGFR				0.459
>15	35.4	52.9	0.834 (0.516-1.349)	
≤15	64.6	57.4		
SBP				0.101*
>130	47	48.4	1.468 (0.927-2.325)	
≤130	53	51.6		
DBP				0.786
>85	9.3	53.6	0.897 (0.411-1.958)	
≤85	90.7	56.3		

Univariate Analysis of Independent Variables

Clinical Characteristics	*Total %*	*% Mature AVF*	*Crude OR (95% CI)*	*P Value*
BMI				
≤30	73.3	55		
>30	26.7	58.8	1.165 (0.694-1.957)	0.563
PT				
≤ 13.4	86.6	56.9		
> 13.5	13.4	50	0.757 (0.389-1.474)	0.413
INR				
≤ 1.2	88	57.6		
> 1.2	12	44.4	0.589 (0.292-1.189)	0.140*
TC				
≤ 5	76	57.9		
>5	24	50	1.294 (0.804-2.084)	0.24*
TG				
≤ 2.1	63.3	53.7		
> 2.1	36.7	60	0.773 (0.48-1.244)	0.289
HDL				
≤ 1.1	51	55.6		
> 1.1	49	56.5	1.037 (0.658-1.637)	0.874
Vein Size				
≤2.5	12.6	26.3		
>2.5	87.4	60.3	4.254 (1.983-9.126)	0.00*

Multivariable Predictors of AVF Maturation

Predictive Variables	*Adjusted OR*	*95% C.I.*	*P Value*
Gender (Male)	0.514	0.308-0.857	0.011
PVD (No)	3.140	1.596-6.177	0.001
V. Size (>2.5)	4.532	2.063-9.958	<0.001

Scoring

Predictive Variables	*Beta Coefficient*	*Error of significance*	*Z Score*	*Adjusted Score*
Gender	-0.666	0.261	-2.55	-2.5
PVD	1.144	0.345	3.316	+3
Vein Size	1.511	0.402	3.76	+4

Total score range from -2.5 to +4

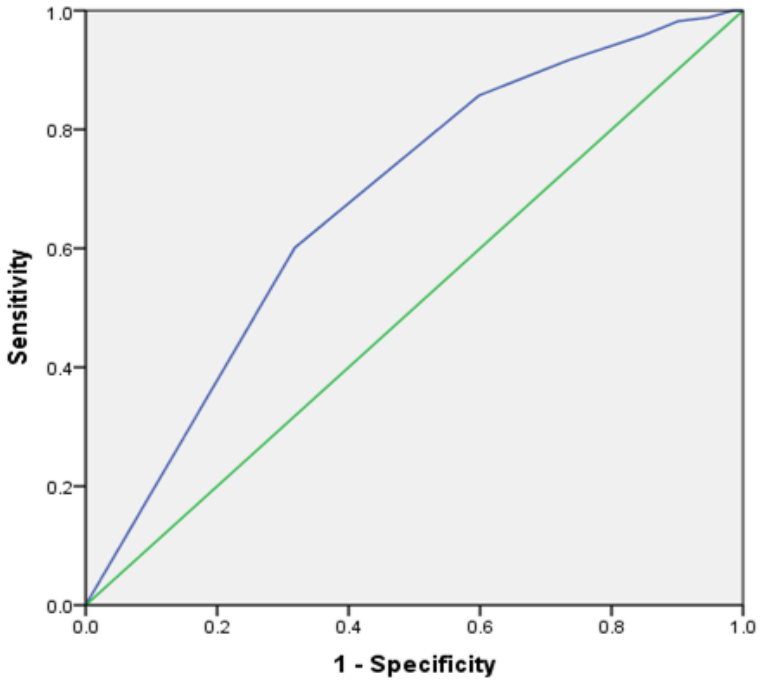
Clinically user friendly predictive model

-log odds of failure of fistula maturation [log/ (1/1- P)] = -1.82 + (-0.666 × Gender) + (1.144 × PVD) + (1.511 × Vein size)

Hosmer and Lemeshow Test

Step	*Chi-square*	*df*	*Sig.*
1	1.045	3	.790

ROC Area



Diagonal segments are produced by ties.

ROC	*Sensitivity*	*Specificity*	*Positive Predictive Value*	*Negative Predictive Value*
0.677	85.7%	40.2%	64.5%	68.8%

The area under the ROC is 0.677, which is indicating 68% ability to discriminate between patients with fistula maturation.

Conclusion

- Gender, PVD and vein size are useful predictors of arteriovenous fistula maturation.

- The clinical significance of these risk categories in the maturation of arteriovenous fistula requires further clinical evaluation.

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- Asif, A., Cherla, G., Merrill, D., Cipleu, C. D., Briones, P. and Pennell, P. 2005. Conversion of tunnelled haemodialysis catheter con-signed patients to arteriovenous fistula. *Kidney Int*, vol. 67, pp. 2399–2407
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- Grassmann, A., Gioberge, S., Moeller, S. and Brown, G. 2006. End-stage renal disease: global demographics in 2005 and observed trends. *Artif Organs*, vol. 30, pp. 895–897